The ART of NUMBRING BY SPEAKING-RODS:

Vulgarly termed

Nepeirs Bones.

By which

The moſt difficult Parts of ARITHMETICK,

As *Multiplication*, *Diviſion*, and *Extracting* of *Roots* both Square and Cube,

Are performed with incredible Celerity and Exactneſs (without any charge to the Memory) by *Addition* and *Subſtraction* only.

Publiſhed by *W. L.*

LONDON;
Printed for *G. Sawbridge*, and are to be ſold at his Houſe on *Clerkenwell*-Green, 1667.

41.
11. 6.
690.

THE *ARGUMENT* TO THE READER.

THE *Right Honourable* John *Lord* Nepeir, *Baron of* Merchiston *in* Scotland; *In the Compoſure of thoſe ever to be admired* Tables *of his Invention called* Logarithms,

finding his Calculations so laborious in long and tedious Multiplications, Divisions, and Extracting of Roots, that his Invention to him must needs render it self very unpleasant, had he not known that the Labour when finished will crown both Him and his Work. He advised with divers Learned men studious in the Sciences Mathematical, and to them (and amongst them) especially to Mr. Henry Briggs, who (by a Learn-

ed

ed and able Divine) was ſtyled (and not without due ~~*reſpect*~~ *deſert) our* Engliſh Archimedes, *to him, I ſay, this honourable Lord imparted his* Invention, *who joyning iſſue with him in this* Herculean Labour, *brought them to that perfection to which they are now (to the admiration of all* Europe*) arrived.*

In the tedious calculation of theſe Numbers, the Author finding his Work to go on but very ſlowly, at

length ſtudying out for ſome help by Art to aſſiſt him in this his Noble Enterpriſe, thinking upon ſeveral helps; at laſt (by the bleſſing of God) he hapned to finde out this which I here intend to deſcribe and ſhew the uſe of, with ſome Additions and variation, from what he hath himſelf done in his Treatiſe *in* Latine, *Publiſhed and Printed at* Edinburgh *in* Scotland, *in* Anno 1617, *Entituled* Rabdologiæ ſeu Numerationis

rationis per Virgulas. *The uses whereof I shall in the following* Tractate *endeavour to render so plain and easie, that he that can but Add and Substract shall be made able in a days time and less to Multiply and Divide any great Numbers, nay, and to Extract both the Square and Cube Roots.*

I have begun this Treatise *with the* Fabrick *and* Inscription *of these* Rods *according to the* Authors *Description, which being*

not so convenient either for Portability or Practice, as some others which I have seen and used, I have described them (I think) in the best manner they possible can be contrived.

For their Use, I am sure I have done more than hitherto I have seen done. and (if I mistake not) to as good and effectual purpose. I do not publish it as a Novelty, neither do I attribute much in it to my self, besides the Method, for had I not

not been desired, I should hardly have thought upon it; however it being done, Accept it and Use it, till I direct something else to thee which may be more acceptable, till when, I bid thee heartily

Farewel.

CHAP.

Fig: 1.

Fig: 2.

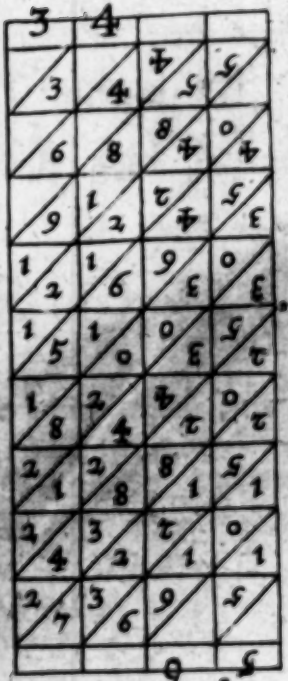
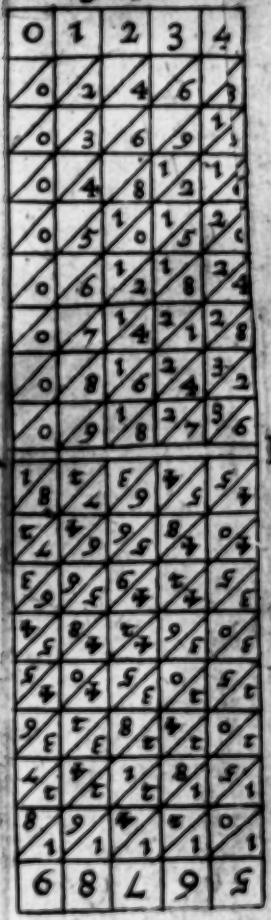


Fig: 3.



Place this Figure at the begining of the Book

Fig: 4.

1	3	4	9	6	3 4 9 6
2	6	8	1 8	1 2	6 9 9
3	9	1 2	2 7	1 8	1 0 4 8 8
4	1 2	1 6	3 6	2 4	1 3 9 8 4
5	1 5	2 0	4 5	3 0	1 7 4 8 0
6	1 8	2 4	5 4	3 6	2 0 9 7 6
7	2 1	2 8	6 3	4 2	2 4 4 7 2
8	2 4	3 2	7 2	4 8	2 7 9 6 8
9	2 7	3 6	8 1	5 4	3 1 4 6 4

The Tabulat with Rods on it

B

Square.

0/1	2	1
0/4	4	2
0/9	6	3
1/6	8	4
2/5	10	5
3/6	12	6
4/9	14	7
6/4	16	8
8/1	18	9

Cube.

6	18	6	2/7
8	29	2	1/5
4	49	3	4/3
9	95	9	1/2
5	25	5	2/1
4	91	4	9/0
3	6	4	2/0
2	4	8	0/0
1	1	1	0/0

CHAP. I.

Concerning the *Fabrick* and *Inscription* Of these RODS.

IN the foregoing Argument I told you, That the Author and Inventer of this kind of Instrument, of which I intend to shew the Use, called it *RABDOLOGIA*, and the Word he thus defines: *RABDOLOGIA est Ars Computandi per Virgulas numeratrices.* That is, *RABDOLOGIE* is the Art of Counting by Numbering Rods.

1. *Of the Fabrick of these Rods according to the Inventors Description of them.*

These Rods may be made either of *Silver, Brass, Box, Ebony, or Ivory*, of which last substance I suppose the were at first made, for that they are (for the most part) by all that know or use them, called *NEPAIRS-BONES*.

But let the matter of which they are made be what it will, their form (according to this description) is exactly a square Parallelepipedon the length being about three Inches, and the breadth of them about One tenth part of the length. But the length of these Rods are not confined to three Inches, but let the length be what it will, the breadth must be a tenth part thereof, but that may be accounted a competent breadth that

is capable of receiving of two numerical Figures, for there is never upon one Rod required more to be set on the breadth thereof.

The breadth of these Rods being exactly One tenth part of the length thereof, when 10 of these are laid together they do exactly make a Geometrical square, and if 20 of them be tabulated or laid together, they will make a right-angled Parallelogram, whose length is double to its breadth. If 30 be tabulated, the Figure will be still a Parallelogram, whose length will be three times the breadth, and so if 40, four times the length ~~—65, so 650, et sic et c.~~

The Rods being thus prepared of exact length and breadth, let each of them be divided into 10 equal parts, with this *Proviso*, that Nine of the Ten parts stand in the middle of each Rod, and the other tenth part must be divided into two parts, half

whereof must be set at the one end and the other half at the other end of the same Rod. Then from side to side draw right Lines from division to division, so is your Rod divided into Squares on every side thereof. Lastly, from corner to corner of every of these Squares draw a Diagonal Line, and that will divide every Square into two Triangles. The Rods being thus prepared and lined first into Squares, and then into Triangles, they are then fit to be numbered.

The Figure i at the beginning of the Book shews the Form of one of these Rods lined as it ought to be.

CHAP.

CHAP. II.

How these Rods are to be Numbred.

IN the two half Squares which are at the ends of each Rod on every side, there are set one single Figure, on each side of every Rod one, in the division at the end thereof, so every Rod containing four sides, Ten Rods will contain 40 sides, and so consequently will have 40 single Figures at the ends of every of them; that is, there will be upon the ten Rods amongst them four Figures of each kinde, that is, four Ones, 1111. four twos, 2222. four threes, 3333. four fours, 4444. four fives, 5555. four sixes, 6666. four sevens, 7777. four eights, 8888. four nines, 9999. four Cyphers, 0000.

And here it is to be noted, That what Figure ſoever it be that ſtandeth at the top of the Rod alone, the Figure that ſtandeth alone on the other ſide of the ſame Rod, maketh that figure up the number 9. As for example; If 1 ſtand on one ſide, 8 will ſtand on the other ſide, ſo 2 and 7 ~~be~~ are: As in this Table, where,

1		8	
2		7	
3	ſtands alone	6	ſtandeth on
4	at the top of	5	the other
If 5	any ſide of	4	ſide of the
6	any of the	3	ſame Rod.
7	Rods, then	2	
8		1	
9		9	
0			

This alſo is to be obſerved in the figuring of every Rod, that what figure ſoever

ever ſtandeth alone at the top or ſuperior part of the Rod, the figure or figures that ſtand in the two Triangles next underneath it, is double to the figure which ſtandeth at the top. And the figures which ſtand in the next two Triangles below, that is three times as much as the figure above. And that in the fourth place, or Triangles, is four times as much as the figure above ~~6550~~, till you come to the loweſt Triangles in that Rod, and then the figure or figures that ſtand in thoſe Triangles are nine times as much as the figure which ſtandeth at the top of the Rod.

So if a Rod have 4 at the top thereof, in the two Triangles which are juſt and next under it, hath only 4 in them, which is equal to 4; in the next two Triangles below, there is 8, which is double to 4; in the two Triangles below them, is 1 and 2, which together make 12, which is

And here it is to be noted, That what Figure ſoever it be that ſtandeth at the top of the Rod alone, the Figure that ſtandeth alone on the other ſide of the ſame Rod, maketh that figure up the number 9. As for example; If 1 ſtand on one ſide, 8 will ſtand on the other ſide, ſo 2 and 7 ~~be~~ &c. As in this Table, where,

	1		8	
	2		7	
	3	ſtands alone	6	ſtandeth on
	4	at the top of	5	the other
If	5	any ſide of	4	ſide of the
	6	any of the	3	ſame Rod.
	7	Rods, then	2	
	8		1	
	9		9	
	0			

This alſo is to be obſerved in the figuring of every Rod, that what figure ſoever

soever ſtandeth alone at the top or ſuperior part of the Rod, the figure or figures that ſtand in the two Triangles next underneath it, is double to the figure which ſtandeth at the top. And the figures which ſtand in the next two Triangles below, that is three times as much as the figure above. And that in the fourth place, or Triangles, is four times as much as the figure above ~~6550~~, till you come to the loweſt Triangles in that Rod, and then the figure or figures that ſtand in thoſe Triangles are nine times as much as the figure which ſtandeth at the top of the Rod.

So if a Rod have 4 at the top thereof, in the two Triangles which are juſt and next under it, hath only 4 in them, which is equal to 4; in the next two Triangles below, there is 8, which is double to 4; in the two Triangles below them, is 1 and 2, which together make 12, which is

three times as much as the 4 at the top; the next Triangles have in them 16, which is four times as much; the next 20, which is five times as much; the sixth hath 24, which is six times as much. The next Triangles have in hem 28, which is seven times 4; the next hath 32, which is eight times as much: And the last Triangles at the bottom they have 36 in them, which is nine times as much. All which is visible by the Figure 2 at the beginning of the Book.

And is evident enough by this little Table following, which is the Table of Multiplication, commonly called *Pythagoras* his Table.

Figures

Figures at the top of each Rod.

The figures in the	0	1	2	3	4	5	6	7	8	9
First	0	1	2	3	4	5	6	7	8	9
Second	0	2	4	6	8	10	12	14	16	18
Third	0	3	6	9	12	15	18	21	24	27
Fourth	0	4	8	12	16	20	24	28	32	36
Fifth	0	5	10	15	20	25	30	35	40	45
Sixth	0	6	12	18	24	30	36	42	48	54
Seventh	0	7	14	21	28	35	42	49	56	63
Eighth	0	8	16	24	32	40	48	56	64	72
Ninth.	0	9	18	27	36	45	54	63	72	81
Square which are	9	8	7	6	5	4	3	2	1	

Times as much as the Figure at the top.

Thus

Thus have you the *Fabrick*, *Inscription and Numbering* of these Rods, according to the Inventor contrivance of them: He make mention of Ten of them, and hat in his Book set the figure of the sai Ten, of one of which Ten I hav given you a Scheme at the beginnin of the Book, which is Figure 2. will now proceed to give you th description of these Rods in anothe more commodious form.

CHAP. III.

A Description of these Rods according to their best and latest Contrivance.

THe Description which I shall here give of these Rods, varies not at all from that before delivered in

the matter of which they are made, for these may be made either in Silver, Brass, Wood, Ivory, &c. Neither do they differ in their dividing, nor yet in their numbering: Only whereas my Lord *Nepair* maketh them square, each Rod to contain four sides, these are made flat, consisting each Rod but of two sides, and contain in length about 2 inches $\frac{2}{10}$. and in breadth $\frac{1}{2}$ of an inch. and in thickness $\frac{1}{12}$ of an inch.

One set of these Rods consisteth of five pieces, and therefore hath but ten Faces or sides, whereas those of the Lord *Nepairs* consisted of 40 Plains or sides.

Upon one of these five pieces (a Figure whereof is at the beginning of the Book, noted with Figure 3) you have a Cypher at the head of the first piece, and 9 at the bottom thereof. Upon the second of them you have 1 at the head, and 8 at the bottom:

upon

upon the third you have 2 at the hea
and 7 at the bottom; upon the fourt
3 at top and 6 at bottom; and upo
the fifth you have 4 at the top, an
5 at the bottom. Every of the tw
Figures at the top and bottom toge
ther make 9; as 0 and 9 is 9, 1 and 8
2 and 7, 3 and 6, 4 and 5. And her
observe, that the Figures 9 8 7 6 5
which stand at the bottom of th
Scheme stand with their heels up
wards, in this manner, 6 8 L 9 S, an
so do all the other figures under them
till you come to the double Lin
which is in the middle of the Scheme
noted with *A* and *B*, at which Lin
if the Scheme were cut into two pie
ces, and folded or pasted on the back
side of the other half, so that the
at the bottom were placed upon th
Cypher at the top, and so 8 upon 1
7 upon 2, 6 upon 3, and 5 upon 4
and then the Scheme cut again int
five little slippets by the down-righ

Lines

Lines; these five slippets would exactly represent one set of these Rods, for upon one side of one of these pieces, you should have a Cypher upon one side, and 9 on the other: Upon the next 1 and 8, upon another 2 and 7, on another 3 and 6, and on the other 5 and 4; both the Figures on either side making 9, as before was described.

These five slippets do now contain the whole Table of *Pythagoras* before mentioned, but ~~for~~ so few are not of sufficient use, neither are the Ten before mentioned of the Lord *Nepair's* order; for there can be but four Figures of one kind, which in all cases is not sufficient.

Therefore as these Rods are made now a days, they do commonly make six sets of them, that is, 30 pieces, which contain 60 faces, and these will be of good use, and there will seldom be found a want, which in those

of

of the Inventors there will often be, except you have a great quantity, which will be far more cumberſom than theſe here deſcribed, for there is required as much Metal or Wood in one of his, as in four of theſe, and then for his Four ſides we have here Eight.

Concerning a Caſe *for theſe Rods.*

For the orderly keeping and ready finding of theſe Rods, I have often (for my ſelf and others) had a Box made of Walnut-tree or Pear-tree, with five partitions in it, each partition to hold five or ſix ſets of theſe Rods, or more if more Rods were required. Every of theſe partitions being figured on the ſide thereof next the Eye, with ſuch figures as the Rods in ſuch a partition had figures at the top, ſo that the party that was to

uſe

use them, could take them as readily out of his partition, as a Printer can take his Letters out of his respective Boxes to make any Word.

In this Box there is also convenient room made for one other Rod, double in breadth to these here described, but of the same length and thickness; upon the one side whereof there is a Table or Plate useful in the Extracting of the Square Root, and on the other side another for the Extracting of the Cube Root, the Figure whereof is at the beginning of the Book, noted with ~~Figure~~ *Square, Cube.* But I shall forbear to say any thing of them, till I come to shew you how to Extract the Square and Cube Roots by the help of them and the Rods.

Of

Of a Board with a Frame, upon which to lay your Rods, when any Operation is to be wrought by them, known by the name of a TABULAT.

In the using of these Rods, care is to be had first of the orderly laying of them, and then secondly, for the keeping of them in that position till your work be ended. For the effecting whereof, both neatly and certainly, there is a little Table or Frame contrived, containing in breadth $\frac{1}{32}$ of an Inch more than the length of the Rods, and in length at pleasure, but it may well be about once and a half the length of the breadth.

It ought to be made of a thin piece of Pear or Walnut-tree, or of such matter as your Box or Case is made of, and it may very commodiously be contrived to be put into the

Box

box as I ever had them made to do, for that I found it inconvenient to carry loose.

Upon the Superficies of this Board, close to one of the edges thereof, must be glewed, or otherwise fastned with Pins, a small piece of the same matter and also of the same length, breadth, and thickness of one of your Rods, which must be divided into 9 equal parts, and Lines drawn cross the piece, so will there be 9 Squares, in which you must Grave or stamp the nine Digits, beginning with 1 at the top, and so descending by 2 3 4 to 9 at the bottom thereof: And it were necessary that these Figures (as also those which are at the head of every of your Rods) were graven or stamped of something a bigger Figure then the other figures of your Rods are.

Under the end of this ledge beginning at the Figures, and so continuing

nuing the whole length of the Board, muſt another ledge of the ſame matter and thickneſs as the other, be glewed or pinned, and then is your *Tabulat* finiſhed. A Figure whereof you have at the beginning of the Book, noted with Figure 4, it is called a *Tabulat*, for that when the Rods are laid thereon, for any Operation to be wrought by them, we uſually ſay, the Rods are Tabulated.

Being thus prepared with Rods and Tabulat, you are ready for the work intended by them, and for which chiefly they were invented.

Thus much for the Fabrick, Inſcription, and Numbering of theſe Rods; let us now come to ſhew the Uſes of them.

CHAP.

CHAP. IV.

To what Uſe theſe Rods generally ſerve.

THe chief Uſes to which theſe ſmall Rods ſerve unto, I in part intimated at the beginning, to which effect I ſhall repeat it again—for by them all manner of Multiplications and Diviſions, as alſo of the Extraction of both the Roots either Square or Cube, are ſo facilly and expeditiouſly performed, and that by the help of Addition and Subſtraction only, that it is (as I may well ſay) inconceivable, for here is no charge at all required of the Memory, and you ſhall aſſuredly take your Quotient Figure in Diviſion always certain; neither too great nor to little, an inconvenience ſo prejudicial, that I leave it to the cenſure of ſuch as have

have found it, to their great loss of time, and other vexation which it hath put them to. But ceasing to say more of their properties, I will now come to shew their Use.

CHAP. V.

How to apply or lay down any Numbers by the Rods.

PROP. I.

Any Number being given, how to Tabulate or lay down the same by the Rods.

LEt it be required to Tabulate or lay down this Number 3 4 9 6.

First, From among your Sets of Rods, (or out of your Case) take four of them, of which let one of them have the Figure 3 at the top thereof, and

and lay it upon your Tabulat close to the edge thereof,; then,

Secondly, Take another Rod from your Case, which hath the Figure 4 at the top of it, and lay that also upon your Tabulat close by the side of the other.

Thirdly, Take another Rod which hath the Figure 9 at the top of it, and lay that upon your Tabulat close by the other two.

And lastly, take a fourth Rod, having the figure 6 at the head thereof, and lay that also upon your Tabulat close by the rest.

These four Rods thus taken, and laid upon the Tabulat, you shall see in the uppermost Row (which standeth against the Figure 1 on the side of your Tabulat) these four Figures, 3 4 9 6, that is 3496, equal to your given Number. In the second Row (against the figure 2 of your Tabulat) you shall finde the double thereof.

of. In the third (against the figure 3) you shall finde the triple thereof. In the fourth the Quadruple thereof. In the fifth the Quintuple; and so on to the ninth and last, in which you shall finde the Noncuple of the Number given.

PROP. II.

How these Rods will appear when Tabulated, and being Tabulated, how to read the Multiplication of that Number so Tabulated, by any of the Nine Digits.

The Four Rods being Tabulated according to the Precepts delivered in the preceding *Proposition*, they will appear exactly as they are represented in *Figure* 4 at the beginning of the Book, which Figure lively represents the four Rods lying upon the Tabulat, which minde well, for upon the true tabulating, and right reading

reading of the Rods so tabulated, depends the whole Work.

The Rods thus Tabulated, and as you see them in the *Figure* 4, do to the eye appear in the form of a Glass-window, every Pane thereof representing a Rhomboyades or Diamond form: In the reading of the Figures which are in these several Rhomboyades or Diamond form, observe these few Directions following, which will fully illustrate the whole business intended, and therefore especially to be minded.

Note,

I. *That the Figures upon the Rods are to be read beginning at the right hand and reading towards the left*; which is contrary to our common course of reading and writing, which is from the left hand towards the right.

II. *That*

II. *That in every Rhomboyades or Diamond, there are either One Figure, or Two Figures, but never more then Two.*

III. *If there be but one Figure in a Rhombus, then that Figure is the Figure to be set down alone* (be it either a Figure or a Cypher) *but if there be two Figures in a Rhomboyades* (as for the most part there is) *then add them two Figures together, and set down their sum in one Figure.*

IV. *But if the sum of the two Figures in one Rhomboyades or Diamond do exceed Ten, then you must set down the overplus above Ten, and keep One in minde, which One you must carry to the next Rhomboyades.*

V. *Note that the first towards your right*

right hand, and the last towards your left hand are but half Rhomboyades or Diamonds, and never have in them more then one Figure onely, but all between them are whole ones, and for the most part have two Figures in them.

VI. *If in either Rhomboyades or half Rhomboyades, you finde no Figures but Cyphers, you must not neglect but set them down as if they were Figures.*

¶ These Rules being rightly understood, all that follows will be familiar and easie, and these I shall explain by Example following.

Example.

For the illustration of the preceding Rules, we will make use of those Rods which were before tabulated,

lated, therefore have recourse to *Figure* 4 at the beginning of the Book, where this Number 3496 is tabulated.

The Figures at the top of the Four Rods are these 3, 4, 9, 6. which signifie the former given number 3496, and this number stands against the figure 1 on the side of the Tabulat. Then I say, that the figures in the next row standing against the figure 2 of the Tabulat ~~and~~ double thereunto, which I thus prove.

Repair to the Rods as they lie upon the Tabulat, and in that row which lieth against the figure 2, you shall finde in the first half Rhomboyade towards your right hand (where by *Rule* 1 you must begin) the figure 2, wherefore set down with your Pen upon Paper the figure 2. In the next Rhomboyades, in the same row you shall finde 8 and 1, which added make 9, set down 9 on the left hand

of

of 2 : In the next Rhombus you ſhall finde 8 and 1 again, which is 9 alſo, ſet down 9 on the left hand of the other, and in the laſt Rhomboyades you ſhall finde only 6, wherefore ſet down 6 on the left hand of 9, ſo have you in all 6992, which is double to 3496.

Again, the figures in the row which ſtands againſt the figure 3 in the Tabulat, are triple to 3496; for in the firſt half Rhomboyades towards your right hand, you have 8, ſet down 8.-- In the next Rhom. you have 7 and 1, which is 8, ſet down 8 again.-- In the next you have 2 and 2, which is 4, ſet down 4.--- In the next Rhom. you have 9 and 1, which makes 10, ſet down 0 and carry 1, but it is the laſt Rhom. and becauſe there is never another to carry the 1 unto, you muſt therefore ſet it down, ſo have you this number 10488, which is triple to 3496.

Again, the figures ſtanding againſt 4 in the Tabulat, are Quadruple to 3496,--- for in the half Rhom. you have 4, ſet it down: in the next 6 and 2, which is 8, ſet that down. In the next 6 and 3 which is 9, ſet that down: In the next 2 and 1, which is 3, ſet that down: and in the laſt half Rhom. you have 1, which alſo ſet down: ſo have you 13984 which is Quadruple to 3496.

Alſo, the figures againſt 5 in the Tabulat: the firſt is a Cypher therefore put down 0; the next is 5 and 3 which is 8, ſet down 8; the next is 0 and 4, ſet down 4; the next is 5 and 2, that is 7, ſet down 7; and the laſt is 1, therefore ſet down 1, ſo have you in all 17480, which is Quintuple to 3496.

Againſt 6 in the Tabulat, you have in the firſt place 6, ſet it down; then in the next 4 and 3, that is 7, ſet that down; in the next 4 and 5, that

is 9, set 9 down; in the next you have 8 and 2, that is 10, set down 0 and carry 1 to the next Rhom. where you finde onely 1, to which add the 1, which you carried from the Rhom. before, and it makes 2, set down 2: so have you 20976, which is six times 3496.

Against 7 in the Tabulat, you have first 2, set it down; then 3 and 4, which is 7, set 7 down; in the next 8 and 6, which is 14, which being above 10, set down 4, and carry 1 to the next Rhom. where you have 2 and 1, which is 3, and 1, which you carried makes 4, set down 4; then in the last place you have onely 2, which set down, so have you in all 24472, which is Septuple to 3496, or seven times as much.

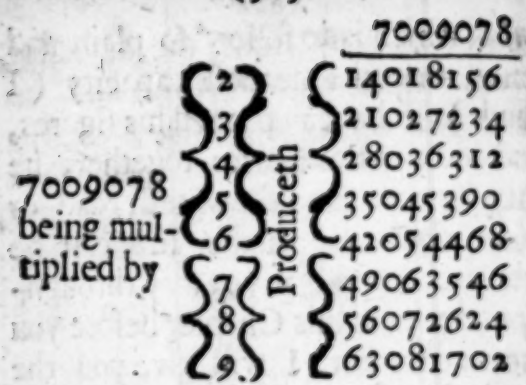
Against 8 in the Tabulat, you have first 8, which set down; then 2 and 4, which is 6, set 6 down; then 2 and 7, which is 9, set 9 down; then 4 and 3,

which is 7, set 7 down; and lastly 2, set that down, so have you 27968, which is Octuple to 3496, or eight times as much.

Lastly, against 9 in the Tabulat, you have in the first place 4, set that down,; in the next you have 1 and 5, which is 6, set 6 down; in the next place you have 6 and 8, which is 14, set down 4, and carry 1 to the next Rhom. where you finde 7 and 3, that is 10, which with 1 which you carried makes 11, set down 1, and carry 1 to the next Rhom. where you finde onely 2 and the 1 carried makes 3, therefore set down 3, and so you have 31464, which is Noncuple to 3496, or nine times as much as the tabulated number.

Thus have I given you Examples, in shewing you how the Numbers upon the Rods are to be read and written down, and in the delivery of this Example, I have made the whole work

work which is to follow so plain and easie, that the meaneſt capacity (I think) if he can but tell his figures, and add any two figures together, he may by this here delivered, read or write down any number that can be tabulated; and that you may throughly underſtand this Chapter before you proceed further, I will give you the Products of 7009078 multiplied by all the nine Digits which I would have your ſelf to tabulate, and ſee if you finde your working by your Rods to agree with thoſe which are here written, which numbers if they do, you need not ſcruple at the moſt difficult that can be propoſed to you, therefore ſtudy it, and try it.



Thus have I sufficiently described these Rods and the manner of Numbring upon them; and now I think it time to apply them to that use for which they were intended, namely, the more difficult parts of Arithmetick, as Multiplication, Division, and Extraction of Roots, but first let me give you

An Admonition concerning Addition and Substraction.

Whereas it was the difficult operations of *Arithmetick*, which by the benefit

benefit of these Rods, the Inventor chiefly aimed at (of which kind he esteemed *Multiplication*, *Division*, and *Extraction of the Square and Cube Roots*) he omitted to say any thing concerning *Addition* and *Substraction*, as things obvious to every *Tyro*, he therefore omitting them, begins to shew the use of his Rods in *Multiplication*, whose Method I shall here follow.

CHAP. VI.

Multiplication by the Rods.

IN Multiplying by the Rods, you are to consider (as in vulgar Arithmetick) three Terms, Things, or Numbers, *viz.*

1. The *Multiplicand*, which is the Number to be multiplied.

2. The *Multiplier*, which is the Number by which the *Multiplicand* is multiplied.

3. The *Product*, which is the sum produced by the multiplying of the two former together.

And here note, that the *Product* doth contain the *Multiplicand*, so many times as there be *Unites* in the *Multiplier*.

Thus for the definition of *Multiplication*, now for the working thereof by the Rods, for which this is

THE RULE:

First, Set down upon your Paper the Multiplicand, and orderly under it the Multiplier. It matters not greatly which of the two given Numbers be made *Multiplicand* or *Multiplier*, but it is usual and best to make the greatest Number *Multiplicand*, and the lesser *Multiplier*. Then

dran

draw a Line with your Pen under them, and having Tabulated your Multiplicand (or greater number) look what Numbers in your Rods ſtand againſt the firſt Figure towards your right hand, and that Number which you ſhall finde upon your Rods ſtanding againſt that firſt Figure found in your Tabulat, ſet down under your Line which you formerly drew under your Multiplicand and Multiplier: And having ſo done with the firſt Figure of your Multiplier, do ſo with the reſt, ſetting them down one under another, removing every Figure one place more towards the left hand, then that which went before it, as is done in common Multiplication, and as you ſee in the following Example.

Example 1. *Let it be required to multiply* 3496, by 489. As if it were required to know how much 489 times 3496 would amount unto.

Firſt, Set down your given Num-

ber

bers 3496, and 489, one under another, and draw your Line uuder them, as here you see done.

Secondly, 3496 your Multiplicand being Tabulated, and 9 being the first Figure to the right hand in your Multiplier, look upon your Rods, what sum there stands against 9 in the side of your Tabulat, and you shall finde (as by the Rules in the second Prop. of the Fifth Chap. you were directed) 31464, which is the Product of 3496 multiplied by 9, wherefore set down this number 31464 under your Line, as you see in the Example.

3496 Multiplicand,
489 Multiplier,

31464
27968
13984

1709544 Product.
Sec.

Thirdly, Look what sum upon the Rods stands against 8, which is the second Figure of your Multiplier, and you

you ſhall finde 27968, ſet this number under the former, moving it one place forward towards the left hand.

Fourthly, Look what ſum upon the Rods ſtands againſt 4 which is the third Figure in your Multiplier, and you ſhall finde 13984, which ſet down under the other, one place more to the left hand.

Laſtly, Under theſe three Sums draw a Line and add the three ſums together, and they make 1709544, which is the Product of 3496 multiplied by 489, and this 1709544 the Product, contains 3496 the Multiplicand, 489 times.

Practiſe well this firſt Example, and compare it with the Rods as they are Tabulated in Figure 4 at the beginning of the Book, as alſo with the Rules in the Fifth Chapter, and you may perform any Multiplication. However I will give you one or two more:

more Examples, and some other ways of *Multiplication.*

Example 2. *Let it be required to multiply the same sum* 3496 by 261.

3496
261
3496
20976
6992
912456

Set the Numbers down as here is done, then look upon the Rods for the Product of 3496 by 1, and you shall finde it to be the same, wherefore set down 3496 under the Line—— then look upon the Rods for thē Product of 3496 by 6, and you shall finde it to be 20976, which set down under the other number one place more towards the left hand.——Again, look in the Rods for the Product of 3496 multiplied by 2, and you shall finde it to be 6992, which set down under the other two.

Lastly, Draw a Line under them, and add the three numbers together in order as they stand, and the sum of

of them will be 912456, which is the Product of 3496 multiplied by 261.

Example 3. *Let it be required to multiply the same number* 3496 by 520.

Set down your Numbers as here you see done — Then because the first Figure of your Multiplier towards your right hand is a Cypher, wholly omit it, and multiply 3496 by 52 only, so shall you finde the Product of 3496 by 2 to be 6992, which set down: Also the Product by 5 will be 17480, which set down under the other one place further, Then draw a Line —— and add these two sums together, and they make 181792, to the which if you add a Cypher for the Cypher which you omitted in your Multiplier, the sum will be 1817920, which is the Product of 3496 by 520.

3496	
520	
6992	
17480	
1817920	

Example 4. *Let it be required to multiply*

multiply the same 3496 by 7003——

Set down your Numbers as before, and as you see here done, Then having Tabulated 3496, see what the Product thereof is upon the Rods being multiplied by 3 the first Figure in your Multiplier, and you shall finde it to be 10488, which set down under the Line——— Then the two next places of your Multiplier being Cyphers, make two pricks under the former number, one under 8, the other under 4, as you see in the Example, or instead of 2 pricks you may make two Cyphers,—Then look in the Rods for the Product of 3496 by 7, and you shall finde it to be 24472, which set down under the other sum, beginning your number at the fourth place, or beyond the two Pricks or Cyphers. Lastly, draw a Line and add these two sums together,

3496
7003
10488
24472 ··
24482488

ther, and their sum is 24482488, which is the Product of 3496 multiplied by 7003.

Thus have you four Examples in *Multiplication*, in which are included all the Varieties that may at any time happen in that Rule, *viz.* Two where the Multiplier consisted all of Figures, as in the first and second Example they did.—Another where the latter place of the Multiplier consisted of a Cypher——And this last Example where Cyphers were intermixed among the Figures.

And thus much for this kinde of Multiplication, but before I leave, I will shew you

Another Form of

MULTIPLICATION.

Whereas in the foregoing Form of Multiplication, which is the best and most

most usual, (only I insert this following for variety.) You began (your Rods being Tabulated) with that Figure of your Multiplier which stands next your right hand, but there is no necessity for that, for you may begin with that Figure which standeth next to your left hand, and by so doing, and placing your several Products one place more to the right hand, as you did before place them to the left hand, those Products added together in the Form they then stand, shall produce a Product equal to the former.

Example, For our Example we will take the first Example before-going at the beginning of this Chapter, where *it was required to multiply* 3496 by 489. Set the Numbers down as before in that first Example, and as you see here done——

3496

3496
489
13984
27968
31464
1709544

Then 3496 being Tabulated, look upon your Rods for the Product thereof multiplied by 4, (which is the first Figure of your Multiplier towards your left hand) and you shall finde the Product thereof to be 13984, which set down.—Secondly, look the Product of 3496 by 8 (your second Figure) and you shall find it to be 27968, which must not be set down as in the other first Example but as you see it in this, 8 the first Figure thereof must be set one place forwards towards the right hand, as in the other it was set a place backward towards the left.—Lastly, seek in your Rods for the Product of 3496 by 9 your last Figure, and you shall finde it to be 31464, which set under the other two Numbers yet one place more to the right hand.—So a Line being drawn under, and these three Numbers

Numbers added together produce 1709544 equal to that in the first Example: And that you may the better see the difference of the work, I have set them one by the other.

As in the first Example,	As in this Example,
3496	3496
489	489
31464	13984
27968	27968
13984	31464
1709544	1709544

One Example more in Multiplication, which shall be for Advertisement and direction, I will give, and so conclude Multiplication.

I said in the general Rule for working of *Multiplication* (at the beginning of this Chapter) that it mattered not which of your Numbers were

were made the Multiplicand, or which the Multiplier, of which I will here give you a Preſident where the leſſer Number ſhall be Tabulated, and the greater Number only ſet down; and I will work it here according to this laſt way of Multiplication, and the Example ſhall be as followeth.

Example, *Let it be required to multiply* 868437 by 3496, and let 3496 (the leſſer Number) be Tabulated.

Let the Numbers be ſet as you here ſee, then 3496 being Tabulated, begin with the firſt Figure towards the left hand of your Multiplier, which here is 8, and upon your Rods find the Product of 3496 multiplied by 8, which is 27968, ſet that down under the Line

```
  3496
868437
 27968
  20976
   27968
    13984
     10488
      24472
3036055752
```

Line — then finde the Product of 3496 by 6 the second Figure of your Multiplier, and you shall finde that to be 20976, set this number under the former one place more towards the right hand.—Again the third Figure of your Product is 8 whose Product is 27968 as before, set that under the other still one place more to the right hand.——In this manner do with the other Figures of the Multiplier, as 4 the next Figure, whose Product is 13984, which also set down a place forward.—So also the Product of 3 which is 10488, which set down.—And lastly, of 7, which is 24472.—All these Products being set down in the order as you see them in the Margent, if you add them together, the sum of them will be 3036055752, which is the Product of 3496 multiplied by 868437, the lesser number being Tabulated.

Other

Other ways of Multiplication I could have added, but these I esteem sufficient.

CHAP. VII.

DIVISION

By the Rods.

AS in Multiplication, so in Division there are three Numbers, Terms, or Things required, *viz.*

1. The *Dividend* or Number to be divided.

2. The *Divisor* or Number by which the Dividend is divided, and

3. The *Quotient*, which is the Number issuing from the Dividends being divided by the Divisor; And this *Quotient* doth always consist of so many *Unites* as the *Divisor* is

times

times contained in the *Dividend*.

Thus much for the *Definition* of *Division*, now let us come to the *Practice* of it by the *Rods*, to perform which, this is

THE RULE

Tabulate the Divisor, (which is always the lesser Number of the two given) and set down the Dividend, and set the Divisor on the left hand, and draw a crooked Line on the right hand for your Quotient, as in common Arithmetick. Then look upon your Tabulated Rods (always) for the Number, less then the Number in the first Figures of your Dividend, and what Figure stands against that Number on the edge of your Tabulat must be the Figure you must put in your Quotient, and that Number you must always substract from the Figures of your Dividend, and to the remainder add another

ther Figure, so proceeding from Figure to Figure till your Division be wholly ended.

Example, *Let it be required to divide* 1709544, by 3496. Having tabulated 3496, set down your Dividend, your Divisor on the left hand thereof, and a crooked Line for the Quotient on the right hand thereof, as by the Rule preceding you were directed, and as you see done in the Example adjoyning.

And because at your first setting down of your Divisor 3496, it would reach (if it were set under your Dividend 1709544) as far as the Figure 5, therefore under the Figure 5 make a Prick to intimate how far you are gone on in your work, and under this Prick draw a Line quite under your Dividend, then is your Sum set down ready for work, and will appear as here you see;

3496) 1709544(

Your Sum thus prepared, ask how often can you have 3496 in 17095, look in your Tabulated Rods for 17095, which you cannot there finde, but the neareſt number thereunto amongſt the Rods, which is leſs then 17095 (for you muſt always take a leſs number) is 13984, which number ſtands againſt the Figure 4 in the Tabulat, wherefore ſet 4 in your Quotient, and 13984 under the Line, and ſubſtract 13984 from 17095, and there will remain 3111, ſo is the firſt part of your Diviſion ended and your work will ſtand thus;

3111
3496) 1709544 (4
13984

Then make another Prick under 4 the next Figure of your Dividend, ſo will

will the remaining number be 31114, —Then look among your Rods for the number 31114 (or the neareſt leſs then it) and the neareſt leſs you ſhall finde to be 27968, which ſtands againſt 8 in your Tabulat, put 8 in your Quotient, and ſet 27968 under 31114, and ſubſtract 27968 from 31114, ſo will there remain 3146, which ſet over head, ſo is the ſecond part of your Diviſion ended, and your work will appear thus;

```
          3146
         3111
3496 ) 1709544 ( 48
        ..
       ------
        13984
         27968
```

Laſtly, Make another Prick under the next Figure of your Dividend, which is 4 alſo, making the remaining number to be 31464, ſeek a-

mong your Tabulated Rods for this number (or the neareſt leſs) but looking you ſhall finde the very number, againſt which ſtands on your Tabulat the Figure 9, ſet 9 in the Quotient, and the number 31464 under the Line, and ſubſtract it from 31464 the remainder which ſtands above the Line, and nothing remains, and being there is never another Figure in your Dividend, your Diviſion is ended, and your work will ſtand thus, and 3496 is contained in 1709544 489 times.

```
                 00000
                 3146
                3111
Diviſor,  ) 1709544 (  Quotient
 3496       ,..        489
          ----------
          13984
           27968
            31464
```

Another

Another Example, and by another way of Division.

Let it be required to divide 912456 by 3496, set down your Dividend and Divisor, draw a crooked Line for your Quotient, and also make a Prick under the fourth Figure of your Dividend, and draw a Line under your Dividend, so is your Sum prepared to be divided, and will stand thus;

3496) 912456 (

Then your Divisor 3496 being Tabulated, look amongst your Rods for the neareſt number to 9124 which is leſs, and you ſhall finde it to be 6992, againſt which ſtands on your Tabulat the Figure 2, ſet 2 in the Quotient, and this Number under the Line, and ſubſtract it from 9124, and there will remain 2132, to which

number add the next Figure of your Dividend, namely 5, and it makes 21325, under which number draw a Line, then will your Sum ſtand thus,

3496) 912456 (2

6992

21325

Then among your Rods ſeek the neareſt number to 21325 and you ſhall finde 20976 to be the neareſt number leſs, againſt which in your Tabulat ſtands 6, ſet 6 in the Quotient, and 20976 under the Line, ſubſtracting it from 21325, which when you have done, there will remain 349, to 349 add the next Figure in your Dividend, which is 6 your laſt Figure, and it makes 3496, under which draw a Line, and your work will ſtand as here you ſee,

3496

3496) 912456 (261
6992
21325
20976
3496

This done, look amongſt your Rods for the neareſt number to 3496, and you ſhall finde the exact number at the top of the Rods, againſt which ſtands the Figure 1 on the Tabulat, ſet 1 in the Quotient, and ſubſtract 3496 from 3496, the remainder is nothing, and ſo is your Diviſion ended, the work ſtanding thus, and 3496 the Diviſor is contained in 912456 the Dividend, 261 times.

number add the next Figure of your Dividend, namely 5, and it makes 21325, under which number draw a Line, then will your Sum ſtand thus,

3496) 912456 (2

6992

21325

Then among your Rods ſeek the neareſt number to 21325 and you ſhall finde 20976 to be the neareſt number leſs, againſt which in your Tabulat ſtands 6, ſet 6 in the Quotient, and 20976 under the Line, ſubſtracting it from 21325, which when you have done, there will remain 349, to 349 add the next Figure in your Dividend, which is 6 your laſt Figure, and it makes 3496, under which draw a Line, and your work will ſtand as here you ſee,

3496

3496) 912456 (26
6992
21325
20976
3496

This done, look amongſt your Rods for the neareſt number to 3496, and you ſhall finde the exact number at the top of the Rods, againſt which ſtands the Figure 1 on the Tabulat, ſet 1 in the Quotient, and ſubſtract 3496 from 3496, the remainder is nothing, and ſo is your Diviſion ended, the work ſtanding thus, and 3496 the Diviſor is contained in 912456 the Dividend, 261 times.

```
3496 ) 912456 ( 261
       ...
       6992
       21325
       20976
        3496
        3496
        0000
```

A third Example ready wrought by the last and left way of Division. I will only set it down ready wrought, leaving the practice of it to your self.

Let it be required to divide 73020506 by 3496.

3496) 73020506 (20886 3050/3496
.....

6992
31005
27968
30370
27968
24026
20976
3050

This Sum thus divided, produceth in the Quotient 20886, and 3050 remaining, so that the Quotient with Fraction and all is,

20886 13050/3496 Which shews that 3496 the Divisor is contained in 73020506 the Dividend, 20886 times, and 3050 remaining.

This Example well practised, together with them before-going, are sufficient instruction for any Student whatever, and he that can perform these need not despair of the most difficult that can be proposed. And so I conclude with Division.

CHAP. VIII.

Concerning the

Rule of Three

OR

Golden Rule,

Both *Direct* and *Reverse*, or *Reciprocal.*

TO Discourse of this Rule at large were to run into a Labyrinth, for it

it was the performance of working Multiplication and Diviſion by the Rods that was here aimed at, and he that can Multiply and Divide may command this *Golden Rule*, wherefore I will ſhew you the nature or order of placing the Numbers, and alſo the manner of working an Example in either of them.

The *Rule of Three* is that Rule which teacheth by having three Numbers in proportion one to another given, to finde a fourth, which ſhall be in proportion to them alſo.

In this *Rule direct* the fourth Number which is ſought, is to have the ſame proportion to the third, as the ſecond Number hath to the firſt: As if the three Numbers given were 2--4-- and 8, ſay, as 2 is to 4, ſo is 8-- to what? multiply 4 by 8 (that is the ſecond Number by the third) and the Product will be 32, which divide by 2 (the firſt Number) the

Quotient

Quotient will be 16, which is the fourth Number in proportion to the third, as the second is to the first; for as 4 the second Number, contains 2 the first Number twice, so 16 the fourth Number contains 8 the third Number twice also.

But in the *Reciprocal Rule of Three*, there the proportion is not as the first to the second, so the third to the fourth: But *as the First is to the Third, so is the second to the Fourth.* As if the Numbers were 3, 4, and 6, say, As 3 the first Number, is to 6 the third Number, so is 4 the second Number; to what? Multiply 4 the second Number by 3 the first Number, the Product is 12, which divide by 6 the third Number, and the Quotient will be 2: for as 6 the third Number, contains 3 the first Number twice, so 4 the second Number contains 2 the fourth Number twice also: And in this consists the difference

ference between the *Direct* and *Reciprocal Rule of Three.*

A Question in each Rule,

1. *In the Direct Rule;*

If four Men eat two Pecks of Corn in one week, how many Pecks will serve an hundred Men the same time?

Men	Pecks	Men.
4	2	100.

Multiply 2 the second Number by 100 the third Number, the Product will be 200, which divide by 4 the first Number, and the Quotient will be 50, and so many Pecks will suffice 100 men the same time.

2. *In the Reciprocal,*

If twelve men do any piece of work in 8 days,

8 days, how many men must be imployed to do the same piece of work in 2 days?

Days	Men	Days.
8	12	2.

Multiply 8 the first Number, by 12 the second, their Product is 96, which divide by 2 the third Number, the Quotient will be 48, and so many men will do the same work in 2 days, for as 8 days is to 2 days, so are 12 men to 48 men, *&c.*

CHAP.

CHAP. IX.

Of the Extraction of ROOTS.

THe Extraction of *Roots*, which is the difficulteſt part of Multiplication and Diviſion, is expeditiouſly and certainly performed by the Rods, for the eaſie and expedite performance of which, there are two Rods on purpoſe, one for the Square, the other for the Cube Root, of which I will ſpeak; firſt, Of their Fabrick: ſecondly, of their Uſe.

Of the Fabrick of the Rods for Extracting of Roots.

Of the ſame matter, and of the ſame length and thickneſs of your other

ther Rods, let there be made another Rod but three times the breadth of the former, the Inscription on one side serving to extract the Square, and that on the other side for the Cube Root, each of which are divided into three Rows or Columes.

That which serveth for the Square Root, hath in the top or uppermost Square between the Diagonal thereof, these Figures 0-1, in the second 0-4, in the third 0-9, in the fourth 1-6, in the fifth 2-5, in the sixth 3-6, in the seventh 4-9, in the eighth 6-4, and in the ninth or lowermost 8-1, which are the Square Numbers belonging to the nine Digits. ——

In the second Colume of the same Rod, in the first Square is inscribed 2, in the second 4, in the third 6, in the fourth 8, in the fifth 10, in the sixth 12, in the seventh 14, in the eighth 16, and in the ninth 18.

In the last or third Colume there

are

are the nine Digits orderly descending, namely, 1, 2, 3, 4, 5, 6, 7, 8, 9. This Rod thus made is fitted for the Square Root.

That which serveth for the Cube Root, hath in the top or uppermost Square of the first Colume towards the left hand between the Diagonal thereof, these Figures, 0-01, in the second 0-08, in the third 0-27, in the fourth 0-64, in the fifth 1-25, in the sixth 2-16, in the seventh 3-43, in the eighth 5-12, and in the ninth 7-29, which are Cube Numbers orderly descending —— The second Colume of this Rod contains these square Numbers, 1, 4, 9, 16, 25, 36, 49, 64, 81, orderly descending. —— The third and last Colume of this Rod hath in it the nine Digits, 1, 2, 3, 4, 5, 6, 7, 8, 9, orderly descending also.

This Rod thus prepared and inscribed, is fit for extracting of the Square

Square and Cube Roots, a Figure of either side whereof you have at the beginning of the Book: That which serveth for the Square Root having the word *Square* written over head, that for the Cube Root, hath *Cube* written over head.

Thus having given you the Fabrick and Inscription of these Rods, I will now shew you their use; And first,

Concerning the Extracting of the Square-Root.

In Extracting of the Square-Root, you must as in common Arithmetick, when you have set down your Number, make a Prick under the first Figure towards your right hand, and so successively under every second Figure, then under those Pricks, draw two Lines parallel whereinto set the Figures of your Root as you finde them: Your Number being thus placed

ced and pricked as before is directed, and as in the following Example you see done, you may proceed to Extract the Root thereof as followeth.

Example 1. Let it be required to finde the Square-Root of this Number 12418576, first, make a Prick under 6, another under 5, another under 1, and another under 2, under which Points draw two Lines, in which you must place your Root, and then will your Number stand thus,

12418576
• • • •

Take the Rod for Extracting of the Square-Root, and look in the first row or Colume thereof for the neareſt Number you can there finde leſs then 12 (which is as far as the first Prick in your Number reaches) and you shall

ſhall finde 9, againſt which in the third Colume you ſhall finde 3, ſet 3 under the firſt point between the Lines, and 9 under the Line, and ſubſtracting 9 from 12, there will remain 3, which ſet over 12, ſo will your Number ſtand thus;

3
12418576
· · · ·
3
9

Then in the middle Colume of your Rod between 9 and 3 there ſtands 6, take therefore one of your Rods which hath 6 at the top thereof, and lay it upon your Tabulat by the left ſide of your ſquare Rod, then being there is 341 to the next Prick, ſeek the neareſt Number leſs upon your two Rods, and you ſhall finde the next leſs to be 325, againſt which in the laſt Colume of your Square Rod ſtands 5, therefore place 5 under your ſecond Prick, and ſet 325 under 341, and ſubſtracting

it

it from 341, there will remain 16, which set over head, then will the Sum appear thus;

16
3
12418576
. . . .
3 5
9
325

And in the middle Colume of your Square Rod against this 5 there stands 10, for this 10 you should take a Rod that hath 10 at the top, but being there is no such, take therefore one that hath a Cypher, and place that between your Square Rod and your Rod of 6, and change your Rod 6 for one of 7, then shall you have upon your Tabulat one Rod of 7, another of 0, and your Square Rod.

Thus must you always do when the Number in the middle Colume exceeds 10.

Then looking upon your Sum you shall finde 1685 to your third Prick; look therefore upon your Rods for the

neareſt

neareſt leſs Number, which you ſhall finde to be 1404, againſt which ſtands 2 in the laſt Colume, ſet 2 between the Lines under the third Prick, and 1404 under 1685, and ſubſtracting it from 1685, and there will remain 281, which place above, ſo will your Sum ſtand thus;

281
16
3
12418576
. . .
3 5 2
9
325
1404

And becauſe the Number ſtanding againſt in the middle Colume of your Square Rod between 1404 and 2 was 4, ſet 4 under your laſt Prick, and take a Rod of 4, and put it between your ſquare Rod and your Rod of 0; and becauſe 28176 remains upon your Sum to the laſt Prick. Look upon your Rods for the neareſt Number thereunto, and you ſhall finde the very Number it ſelf to ſtand againſt the

Figure

Figure 4, ſet therefore 28176 below, and ſubſtract it from that above, and there will remain nothing, which denotes the Number 12418576 to be a ſquare Number, and the Root thereof to be 3524, and the work finiſhed will ſtand thus;

```
                00000
                 281
                16
               3
Square        12418576
               . . . .
              ---------
              3 5 2 4   Root.
              ---------
              9
              325
               1400
                28176
```

This Sum had it been wrought by that ſecond way of Diviſion, which I ſhewed in Chapter 7, it would ſtand as followeth;

Square

Square 12418576 (3524 Root.

9
341
325
1685
1404
28176
28176
00000

Caution.

If at any time you look for the remainder upon your Rods, and you cannot finde it there, you must then place a Cypher between the Lines, and proceed to the next Figure, as by trying this other Example which I have inserted for practice will appear.

Another

Another Example added for Practice.

90

54895

67

21

2

. . . . . .

1177162376 94

3 4 3 0 9 8

9

256

2049

617481

5489504

CHAP. X.

Concerning the Extraction of the Cube Root.

THere is somewhat more difficulty in Extracting of the Cube, then

then of the Square Root. Wherefore (before I come to Example) I will deliver the manner of the Operation, together with such Cautions as are to be observed in the performance thereof; All which immediately follow in this

GENERAL RULE.

Write down the Number whose Cube Root you are to Extract, and under the first Figure towards the right hand make a Prick or Point, and so under every third Figure towards the left hand, till you come to the end of your Number. Under these Pricks draw two Parallel Lines, (as you did in Extracting the Square Root) between which Lines you are to place the Figures of your Root as you finde them;—Then beginning at the Figure (or Figures) of the left hand Prick, and going forward towards the right hand, Extract (by help of the Rod for Extracting

racting the Cube Root) their Root, (or if the true Number be not on the Plate, then the nearest less, and placing this Root, (which never exceeds one Figure) between the Lines, and under its Point, and take its Cube from the uppermost Figures, which stand before (or leftwards) of the first Point, and note the Remainder above.

Secondly, Keep the Triple of this Root sound, in the head or top of the Rods, and triple the Square of the same Root, and set this Triple on the head of the Rods, and apply it leftwards of the Cubick Rod, and the reserved Rod (or Rods) right-wards, the Cubick Rod being in the midst between them, and out of the left hand Rods and the Cubick Rod together, pick or finde out the Multiple, (or next less Number) then the Figures preceding the second Point, which write apart in a Paper, and note its Quotume over its utmost right-hand Figure, and write the

Square of that Quotume left-wards from the Quotume it self, even in that order as you finde them in your Cubick Rod, and under every several Figure of this Square, write their Multiples found right-wards, even such as the Figures themselves do shew. So that every Multiple may end under its Figure or Quotume; then add together these Multiples cross-wise, and take their sum from the Figures foregoing the second Point, and write the Remainder over them, but write the right-hand Quotume before noted under the second Point between the Lines, for the second Figure or Quotume of the Root: And so is performed the Operation of the second Point, which you must repeat through the several Points, even to the last.

But in the practice by this Rule, you may sometimes be at a stand, wherefore to this *GENERAL*

RULE

RULE (that there may be no obstacle) I will add these two CAUTIONS.

I. CAUTION.

But in all Operations and Points it must be observed, *That if no Multiple (no not the least of all) found in the left Rods, and the plate, may be substracted from the foregoing Remains, then a Cypher* [0] *must be put under that Point for the Quotume, the Remains being untouched, and abiding as before.*

II. CAUTION.

And if the aforesaid Sum to be taken away, cannot be taken from the Figures going before its Point, the smaller Multiples must be added, which the next upper Quotumes in the

Cubick Rod do ſhew in the Rods, whoſe Sum may be taken away therefrom.

EXAMPLE

Of the

Cubick Extraction.

Let 220226356 27 be a Number given, whoſe Cube Root you deſire: Set down your Number, and point it, (beginning at 7 the laſt Figure towards the right hand, and ſo under every third Figure) and draw two Parallel Lines under it, and it will ſtand in this manner;

2 2 0 2 2 6 3 5 6 2 7

Look in your Rod for the Extracting the Cube Root, for the nearest Cube Root of the Figures of your given Number standing before the first Point towards your left hand, namely for the nearest Cube Root of the Number less then 22, which you shall finde to be 2, which set between the two Lines just under the first Point, and its Cube (which is 8) set under the Line, and substract it from the Figures above the Line, namely from 22, and there will remain 14, which place orderly above, then will your work stand thus, and the work of your first Point finished.

```
14
22022635627
 .   .   .   .
_____ _____ _____
 2
_____ _____ _____
 8
```

 Secondly,

Secondly, For the finding of the Root belonging to the second Prick, triple the Quotume or Figure which is under the first Prick (namely 2) and it is 6, finde therefore a Rod which hath 6 at the head thereof, and lay that Rod by the side of your Cubick Rod towards the right hand, then triple the Square of 2 (which is 4) and it makes 12, which found among the Rods, place bythe side of the Cubick Rod towards the left hand.

Then from the Rods which lie on the left hand of the Cubick Rod, and the Cubick Rod it self, finde the neareſt leſser Number then the Figures ſtanding before the ſecond Prick, namely, leſs then 14022, and in the ninth place you ſhall finde 11529, which write by it ſelf as

in the Margine, and over 9 the last Figure towards the right hand (drawing first a Line between) set its Quotume, and by it its Square 81, in the same order as you finde them stand in your Cubick Rod.

	819
	11529
	6
	48
	16389

Then write under 1, its Multiple, which is shewed right-wards against 1 in the Cubick Rod, and is the single Figure 6, and under 8 write the Multiple that it shews right-ward against 8 in the Cubick Rod, which is 48, and these three Multiples so written cross-wise below the Line, and added together (as in the Margine) do produce 16389, which, because they cannot be taken from the upper Figures standing before the second Point, namely from 14022, the Number 9 (before taken) is to be rejected, as being too great, and instead of 819 (by the second Caution)

tion) the next higher Notes in the Plate are to be taken, which are 648, and the Multiples that these do shew, namely the Octuple among the left Rods, which is 10112, and the Quadruple among the right Rods which is 24, and the Sextuple among the right Rods, which is 36, being added cross-wise (as in the Margine) do produce 13952, which substracted from 14022, (the Figures standing before the second Prick) there remains 70 for the remain of the second Prick, and let there be taken for the Quotume of the second Prick, the right-most of the chosen Figures 648, which is 8, which place under the second Point between the Lines; so is the second Figure of your Root found, and your work will stand thus,

```
  648
-------
10112
   24
  36
-------
13952
```

70

14

2202263562 7

2 8

8

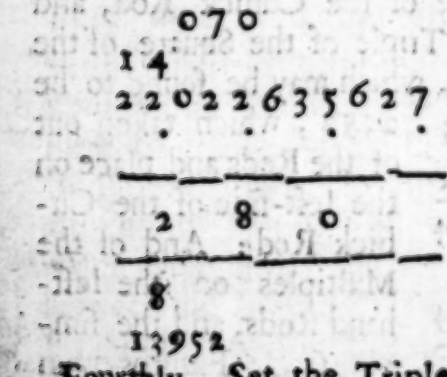
13952

Thirdly, Put the Triple of the precedent Quotumes (*viz.* 28 between the Lines) which is 84, being taken out of the Rods, and put them on the right-side of the Cubick Rod, and get the Triple of the Square of the same 28, which may be found to be

28
28
224
56
784
2352

2352, which taken out of the Rods and place on the left-side of the Cubick Rod: And of the Multiples on the left-hand Rods, and the simple single Figures upon the Cubick Rod (the least

least of which being 235201) there is none so little that may be substracted from the Figures belonging to the third Point, namely from 70635; Therefore (by the first Caution) the Remains abiding, or continuing as they are, you must put a Cypher under the third Point, for the third Quotume belonging to the third Point: And thus the Operation of the third Point is accomplished, and the work will stand as followeth;



Fourthly, Set the Triple of the foregoing Quotumes (*viz.* 280) which

which is 840 on the right-hand, and the Triple of the Square of the same 280, which is 225200 on the left-hand, and the Cubick Rod between them; Then out of the left-most Multiples, choose that which is next less then the Figures belonging to the fourth Point, namely 70635627, which is this 70560027, which stands against 3 on the Tabulat, wherefore write this Number 70560027 upon Paper as in the Margine, with a Line over it, and set over the Line the Quotient 3, over its right-most Figure, and the Square of the said Quotume 3, which is 9, left-ward thereof, and the Noncuple found in the right-hand

280
280
22400
560
78400
3
235200
93
70560027
7560
70635627

hand Rods, which is 7560 write under 9, let these two Multiples be added as in the Margine, and the Sum will be 70625627, which substracted from the Figures foregoing the fourth Prick, and there will nothing remain; therefore let the right-most of the Figures of 93, *viz.* 3, be placed under the fourth and last Point, for the fourth and last Quotume of the Root, and so the whole and perfect Cubick Root of the given Number 22022635627, is 2803, and being nothing remained, it is a perfect Cubick Number. The like is to be done in other Numbers, but I shall forbear to give you any more Examples, there falling out in this all the variety that at any time may happen for the *General Rule* and the two *Cautions* before premised are here made applicable to Practice; wherefore to this Treatise for the present I will put

An End